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SCIENCE AND TECHNOLOGY

No. 48

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26 February 1981

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26 February 1981

WEST EUROPE REPORT

SCIENCE AND TECHNOLOGY

No. 48

CONTENTS

CHEMICALS

GOVERNMENT TO STUDY USE OF PRODUCER GAS IN DIESEL ENGINES

Stockholm SVENSKA DAGBLADET in Swedish 9 Jan 81 p 3

[Article by Eric Johansson, head of the State Machine Testing Office: "The Producer Gas Alternative"]

[Text] The rapidly increasing motorization, together with the fact that the Otto engine (carburetor engine) has been totally supplanted by the diesel engine in tractors, trucks and buses, has required new research and development efforts in the field of producer gas. For this purpose cooperation was initiated almost immediately after World War II between the then National Commission for Economic Defense Preparedness and the State Machine Testing Office. Since then the State Machine Testing Office has been responsible for the existing state research and development activity for producer gas operation of modern diesel engines. The function of the National Commission was later assumed by the National Board for Economic Defense.

Most recently, the State Machine Testing Office has tested three standard types of producer gas units both in a dynamometer test and in practical use for ordinary professional farmers and truck drivers. Twelve tractors, six trucks and one bus have been tested since 1961. The tractors were used in normal agricultural and forest operation during more than 15,000 hours, and the trucks were driven more than 667,000 kilometers. One of the tested trucks has been driven 200,000 kilometers since 1975 without any form of engine overhaul. It required little lubricating oil and its efficiency was acceptable at the end of the testing period.

The function of the apparatus has been adjusted to the diesel engines of today. Industrial wood chips and blocks were used as fuel. The goal of the development work has been to simplify maintenance and increase operational reliability in the producer gas units.

Accomplishes the Tasks

If an Otto engine, which is usually found in passenger cars, is totally converted to producer gas operation, it will lose about 40-50 percent of its output. If a diesel engine is converted to producer gas while using about 10 percent of the normal fuel quantity at various engine loads, it will lose about 30 percent of its efficiency.

If a diesel engine with a supercharger, for example a turbine compressor, is converted to diesel/gas operation, engine output drops even more than in the ordinary diesel engine. The turbine compressor has to be removed, which reduces engine output by about 20 percent. In addition, efficiency is reduced by 30 percent in the same way as in the ordinary diesel engine when operating on the dual fuel of diesel oil and producer gas. If we choose a modern diesel engine tractor with a 100 kilowatt supercharger, it will have a capacity of only about 55 kilowatt when used in diesel/gas operation.

It is entirely clear that the above-mentioned reductions in output cause certain difficulties in practical work, but the producer gas-driven tractors will be able to handle their work assignments. It is a matter of choosing a lower gear, which reduces the speed of operation and increases the time required to accomplish a given task. It is also possible to raise one or more shares on a plow with many shares, as well as disconnect one section of a harrow or dismantle some of the pegs on a cultivator.

There is actually a positive effect of the reduced output of the engine. The skidding of the wheels will be reduced. A better balance for Swedish agricultural conditions will be achieved between available engine output and wheel equipment as well as tractor weight when operating with producer gas rather than with ordinary diesel operation.

Only Alternative

Due to the lack of funding, the State Machine Testing Office has not been able to work on seeking solutions to the problem of producer gas operation of supercharged diesel engines. Up to now persons responsible for emergency preparedness planning have regarded the proportion of supercharged diesel engines to be too small for ordinary agricultural tractors. In 1980 the number was about 7,000 out of the approximately 180,000 tractors in agriculture. The proportion is higher for trucks and buses. Information in foreign literature indicates that solutions might be possible, but both experimental work and practical testing under Swedish conditions are required.

Peter Lennby states that conversion time for the beginning of large-scale production of the single-unit apparatus that was tested with the allocated resources is 7 months. That time could be reduced to 3 months if the state authorities make a decision to invest about 30 million crowns in the necessary production tools. The National Board for Economic Defense has asked for this amount in its budget proposal, but neither the government nor Parliament have appropriated the necessary amount.

With the presently available knowledge and with presently known Swedish raw materials producer gas is Sweden's only practical domestic emergency preparedness alternative for engine fuel during the 1980's as well.

11949
CSO 3102

ENERGY

REPORT GIVES GOVERNMENT ENERGY OBJECTIVES FOR 1990

Paris SCOOP ENERGIE in French 15 Dec 80 p 3

[Article: "The Event: Annex 5 of Mr Gantier's Report"]

[Text] Gilbert Gantier, deputy from Paris, special rapporteur for industry in the context of the general report of the Finance Committee on the budget bill for 1981, summarized in an annex (No 5) the French Government's energy goals for 1990. Here is the summary, which probably contains no new figures but rather constitutes a synthesis deserving the reader's attention:

1. Goal for 1990: To reduce France's oil dependence to one-third of the energy total (compared to two-thirds in 1973 and 56 percent in 1979) by means of the following:

1-1. An active conservation policy slated to limit total consumption to 242 mtep [or MTEP--millions of petroleum equivalent tons] for an economic growth of 3.5 percent a year and an elasticity* reduced to 0.6. Encouragement of public transportation; less automobile fuel consumption; stricter standards for the thermal insulation of buildings; and more moderate industrial technologies. Compared to earlier projections, a saving of 60 mtep is targeted for 1990 (18 mtep have already been realized in 1979).

1-2. Development of alternative energy sources:

Coal: Improvement of domestic resources under acceptable economic and human conditions; development of resources outside the national territory; promotion of industrial and collective uses.

"New" sources of energy: 10 to 12 mtep, including energy originating from plants of 7.5 to 9 mtep.

Gas: Increased but diversified and competitive imports.

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*Elasticity: Ratio between increased energy consumption (in this case 3.5 x 0.6 = 2.1 percent) and the corresponding growth in production.

Nuclear energy: Realization of the program and more intense penetration of electricity.

2. Means used:

a. Modification to provide incentives through the differential prices of various forms of energy.

b. "Ad hoc" investments of public enterprises.

c. Intervention of the public authorities by providing information, training, and innovation. Gilbert Gantier recalled the amount of government assistance in 1980. In all, such aid aggregated 2.066 billion francs of which the Agency for Energy Conservation accounted for 24 percent; the Commission for Solar Energy, 7 percent; the geothermal sector, 2 percent; improved housing, 37 percent; tax assistance, 14.5 percent; and oil exploration, 15.5 percent.

3. Comparison with the International Energy Agency (AIE) [of the Organization for Economic Cooperation and Development] and three of its members:

a. AIE: Its objectives are close to those of France.

b. United States: By 1985, annual growth in demand below 2 percent; fuel consumption 10 percent below present level; oil imports of 400 mtep only; coal, 1 billion tons a year; 90 percent of homes will be insulated; use of solar energy.

d. Japan: Growth in consumption of 4.8 percent a year between 1978 and 1985 and of 4.4 percent between 1985 and 1990; elasticity of 0.8 and 0.88, respectively.

FRG: Improvement of domestic heating yields through subsidies and tax benefits; development of coal consumption; prohibition of construction of new power plants using fuel oil or gas; diversification of energy sources; increase in overall consumption as follows: +3.1 percent a year between 1979 and 1985; +1.9 percent a year between 1985 and 1990. Elasticity, 0.76 and then 0.54, respectively.

2662
CSO: 3102

ENERGY

MINI NUCLEAR REACTORS DEVELOPED FOR DISTRICT HEATING

Frankfurt/Main FERNWAERME INTERNATIONAL in German Dec 80 p 463

[Article by GRS: "District Heating Via Thermal Reactors"]

[Text The French Atomic Energy Commission (CEA) has dropped most of its technical reservations about the mini reactor prototype to be used in heating residential areas, as was recently reported in an information summary from the GRS [Scientific Research Group]. A too low water outlet temperature previously stood in the way of construction of this type of 100-MW thermal reactor, with which part of Grenoble is to be heated. Now the temperature has been successfully raised by 10° C to 103° C. The resulting higher heat output makes the system economically attractive for use in smaller communities.

Jean-Pierre Perves, one of the engineers working on the thermal project at the CEA's Centre d'Etudes Nucleaires de Grenoble (CENG), explained that the rise in the water outlet temperature was achieved by two fundamental technical changes in the reactor layout. First, straight-tube steam generators were specified instead of the steam generators with U-tubes usually employed in French (and Westinghouse) pressurized water reactors. Furthermore, the engineers had made the decision to install three instead of two primary coolant pumps. The first change, it was said, resulted in a temperature increase of 5° C, and the temperature was raised an additional 4 to 5° C by the second change. An additional slight increase could be achieved by other smaller changes.

Representatives of Grenoble's city authorities claim that in very cold weather a water temperature of 180° C is necessary to guarantee adequate home heating. CEA spokesmen point out however, that many heating systems operate with water at 120° C, so nuclear heating at 130° C is far more attractive.

The construction cost of a 100-MW prototype reactor is estimated at $62.5 million, the complete expanded system, including pipes in the city, at about $100 million. Although the thermal project can expect state support, the mayor of Grenoble, Hubert Dubedout, is still not convinced that this system is the best option to meet his city's heating requirements. In any case, according to Dubedout, the project must not cost the citizens of Grenoble a penny.

According to estimates by city officials, Grenoble could save the equivalent of 26,000 tons of oil annually. The CEA thinks these figures are too low. It estimates savings of 30,000 to 35,000 tons per year. Work on further improvements to

the technical and economic aspects of the thermal project are being continued by the CEA. At the beginning of the coming spring it hopes to be able to present a complete dossier to the city of Grenoble. After a public hearing, the responsible Grenoble authorities will make their final decision.

Working against this decision is the desire of the CEA to build the prototype reactor on the CENG site at the city's edge for the sake of easier technical investigation during operation. This location is not ideal, however, for the area of the city to be heated, since the hot water feeder lines would have to be disproportionately longer and costs would increase by between $12.5 and $15 million. Members of the CEA regard these costs as special expenses which must always be expected with prototype projects.

Perves commented that if the new French law passes supporting the development of district heating in France, the thermal reactor, if it is started up in Grenoble, could become a winner for the French province on the home market.

9581
CSO: 3102

BUDGET, STATUS, SITES OF GEOTHERMAL RESEARCH, SOURCES

Paris LE MATIN in French 17-18 Jan 81 p 13

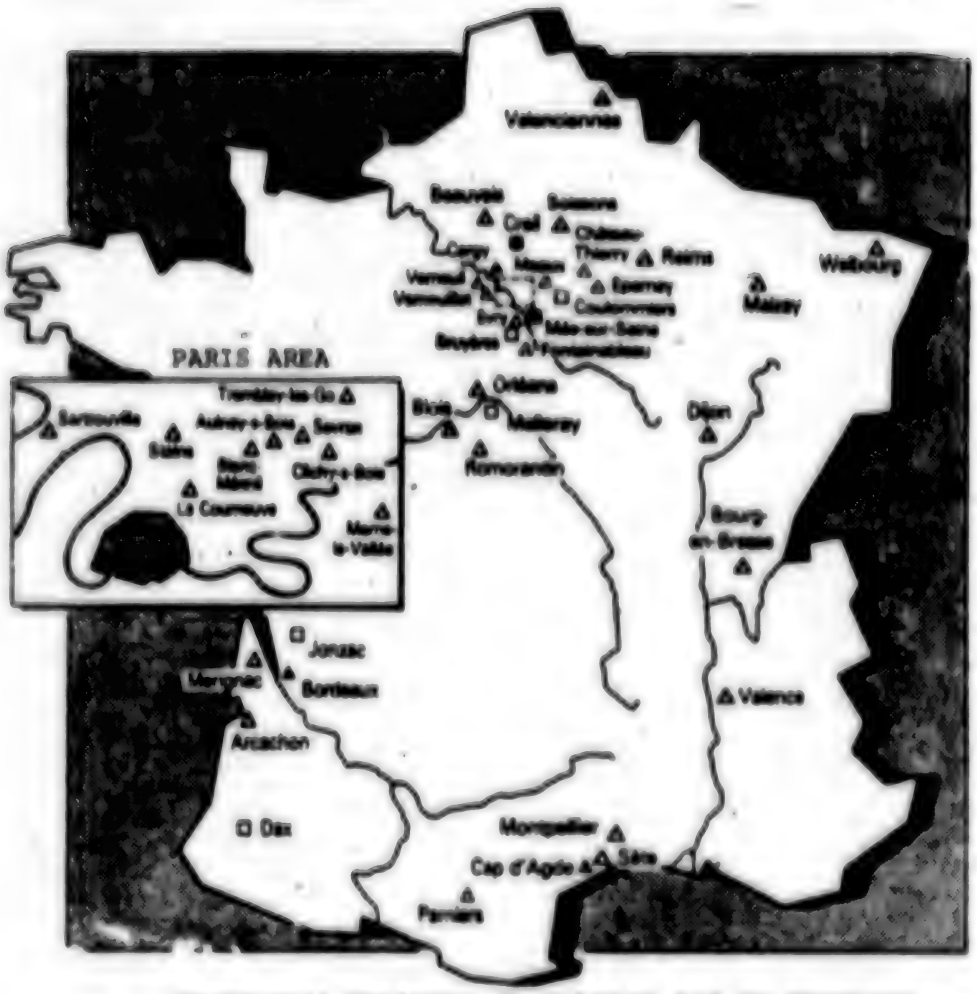
[Article by Robert Clarke: "Energy: Geothermal Energy Comes Into Its Own"]

> [Text] This year its budget will double and the number of drillings should increase to about 20 per year. Objective: to save one million tons of oil equivalent by 1990.
>
> For geothermal energy, the year 1980 will have marked the transition to the industrial development stage. Officials of the BRGM (Bureau of Geological and Mining Exploration), the leading experts in the field, hope to reach soon the projected rate of 15 to 20 installations per year. The heat recovered from underground hot-water tables is expected to save one million tons of oil by 1990.

The budget of the geothermal energy committee is intended to help in financing exploratory drillings for underground water at temperatures ranging from 50 to 100°C, which can be used to heat homes or hothouses; it will double in 1981, increasing to 60 million francs. It is estimated that a total of one billion francs will be invested for the exploitation of geothermal energy in 1990. About half of that will be spent in 1981.

The operation has already proved profitable. Although expensive (10 to 15 million francs), the drillings to find hot water, sometimes at depths of over 1,000 meters, pay off in 6 to 9 years at most, thanks to the savings on oil products.

In Creil for instance, where geothermal energy has been used since 1976 to heat a 4,000-home complex (water at 57°C is drawn from 1,650 meters underground), the users' heating costs were reduced by 35 percent last year. The Melun l'Almont installation, dating back to 1969, is supplying 3,000 homes and makes it possible to save 1,500 tons of oil each year. At Mellerey near Orleans, the owners of 15 hectares of hothouses, who had had to reduce their production because of increased fuel oil prices, expect to recover in 5 years the 20 million francs they have invested in drilling



Geothermal Projects, Completed And In Progress

- ■ In operation
- □ Drilling completed - waiting for surface installations
- ▲ Project in progress
- △ Project under study

1,600-meter deep wells. Geothermal energy will enable them to resume normal operation; without it, they would have had to curtail their production still further.

The list could go on and on. In Dax, underground hot water will supply a 500-bed hospital and hundreds of homes, thus saving 2,500 tons of fuel oil per year. Tests at the well of the newly developed Cergy-Pontoise township will start in a few days: in addition to 2,400 homes, this well will supply school complexes, stores and various municipal facilities. In 1981, the BRGM expects to start drilling at Bourg-en-Bresse, Romorantin, Chateau-Thierry, Blois, Beauvais, Reims and Fontainebleau--to name only a few sites.

The objective is to increase the number of drillings from 8 (in 1980) to some 20, then 50 per year. Half of this program will be realized by BRGM personnel, the remainder by other specialists attracted by the well-deserved and economically appealing popularity of geothermal energy. At the same time, industries (drying of corn, malt factories) have also shown interest in this method of heating, the use of which should expand as geologists continue work to complete their inventory of the sites where interesting underground hot-water tables can be found.

9294
CSO: 3102

MINISTRY OF INDUSTRY STUDIES ALCOHOL FUELS

Paris ENERGIE in French 25 Nov 80 p 15

[Text] The Ministry of Industry is currently completing studies for a fuel project which makes partial use of agricultural products: carburol.

The definition of a fuel program not based on oil is one of the 29 priority actions which the president of the French Republic has assigned to the government for the end of the 7-year period.

This carburol project (the term is a neologism combining *carburant* [fuel] and *alcool* [alcohol]) should be presented to the Cabinet as soon as studies are sufficiently underway, probably before the end of the year. In order to be viable and credible, such a program must in the long run make it possible to produce at least 10 percent of the nation's fuel needs, which currently amount to 17.6 million tons (plus 9.5 million tons of diesel fuel), for a consumption of 100 million tons of oil yearly in France.

It is important to choose a plant that will give good yield on our nation's land and that can be distilled with the lowest possible expenditure of energy. It is in fact a matter of not using any more energy for the collection and distillation of the agricultural product(s) than the fuel substitute obtained represents.

It is generally thought that the operation would be profitable if it did not cost more, energywise, than its equivalent in coal. Beets and corn (whose alcohols are well-known) are obviously among the possibilities, but preference seems to be going to the Jerusalem artichoke, whose tops constitute a substantial energy contribution.

While using artichokes to power vehicles may seem utopian in France today, filling automobile tanks with sugar cane alcohol is already a reality in Brazil. In 1980, some 3.8 million tons of that alcohol were produced and mixed in a ratio of 20 percent alcohol and 80 percent gasoline. The objective is to approach 11 million tons by 1985. By this year, over 200,000 out of the 1 million automobiles built in Brazil had been equipped to use alcohol.

Other Latin American countries are preparing to follow the Brazilian example, while the Japanese Government, according to LES NOUVELLES SCIENTIFIQUES ET TECHNIQUES DU JAPON, has just concluded a biomass development contract with 17 enterprises. The rice stalks and hulls, now unused, must be turned into alcohol, representing the equivalent of 20 percent of Japan's total gasoline consumption.

11,464
CSO: 3102

ENERGY

BREMEN FIRMS BUILD ROTOR FOR SWEDISH WIND ENERGY CONVERTER

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 13 Jan 81 p 5

[Article: "Crack Warning System for the Aeolus Rotor"]

[Text] re. Frankfurt, 12 January..The Bremen companies ERNO and United Flight Technologies are presently engaged, under a Swedish Government contract, in the construction of a 75-meter diameter rotor for a wind energy converter. The wind power plant, named "Aeolus," will go into operation on Gotland Island in 1982. Aeolus has an installed power of 2 MWh, which is enough power to supply 1,000 single-family dwellings. In connection with this design, attention is being focused on two main areas: 1) Optimizing the dimensions and design of the rotor blades and 2) Choosing the type of construction and quality control procedures for building blades with precision contours and long fatigue life, while at the same time keeping cost within reasonable bounds.

The task of a wind energy converter is to produce energy at the lowest possible cost; consequently, initial cost, repair and maintenance costs and operating life play important roles. Plastic materials reinforced with glass or carbon fibers are presently ruled out for the load-carrying structure because of the risk and cost compared to metals, according to the companies. During the design phase it was shown that a mixed construction represented the best solution from the standpoint of cost. In this type of construction, a steel torsion box carries the blade load and the aerodynamic nose and trailing edge sections use glass fiber reinforced plastic. To facilitate maintenance and periodic inspections of the metal parts, the outer surface of the steel spar forms part of the aerodynamic contour. Here, stringent requirements are placed on the welding and manufacturing craftsmen because close tolerances must be held in the required aerodynamic coefficients.

On the other hand however, this method of construction avoids laid-up, bonded or riveted plastic laminates, which for one thing are too labor-in-tensive and for another represent a risk factor for fatigue life. In addition, such layered plastic construction makes it difficult to periodically inspect for possible fatigue cracks; and one must assume from the start that in metal construction, in spite of careful control, small notches or cracks will occur in the material or the welded seams.

In the case of the rotor blades for the wind energy converter, the maximum static loads can be considered negligible compared to the peak and oscillatory loads which

in some cases can have an effect that is more than 2×10^8 as great. Conventional fatigue calculations had to be greatly extended to assure a 30-year life for the rotor. In addition to fatigue strength calculations, crack propagation calculations in fracture mechanics had to be further developed also in order to predict the propagation of cracks in thick plates.

Fatigue tests with appropriately prepared samples have fully confirmed the results of calculations, according to the firms. Simultaneously, a crack warning system is also being tested for inclusion in the rotor blades in order to extend the inspection interval during operation for an acceptable trade-off between economics and risk.

9160
CSO: 3102

LITTLE FUTURE SEEN FOR WAVE, TIDAL ENERGY USE

Duesseldorf MT MEERESTECHNIK in German Dec 80 p 222

[Text] Within the framework of its energy research program the FRG government is investigating the possibility of obtaining energy from the sea. However, results so far show that only minimal contributions to meeting energy needs can be expected in this way. According to figures from the Ministry for Research, using tidal energy along the coasts of Germany makes little sense, mainly because of the small tidal range and topographical conditions. This also applies to using wave energy because of the insufficient usable coastlines and insufficient average wave height.

Independently of these determinants on the national coastline, the government is attentively following international developments in the use of energy from the sea, particularly wave energy, in the context of the activities of the International Energy Agency. In this context the Ministry for Research and Technology (BMFT) has commissioned a study in which the technical and economic possibilities of wave energy are studied, particularly with respect to decentralized energy supplies in developing countries. The authors of the study think that concepts for plants under 100 kW for the generation of energy or the production of drinking and usable water through desalination have good prospects.

Good chances of realization are accorded to the utilization of temperature differences in warm waters, while utilization of salinity differences is still undetermined. The use of salinity differences is tied to the exchange of large quantities of fresh and brackish water. At the present time the government is following this concept only through scientific observation. Since the use of temperature differences could possibly be of interest to developing countries, a joint project with a developing nation is being considered for the future.

9581
CSO: 3102

BRIEFS

NUCLEAR DISTRICT HEATING--Andre Giraud advocates using district heating. The systematic recuperation of heat produced notably by thermal and nuclear power plants will make it possible for France between now and 1990 to save 5 million petroleum equivalent tons (TEP), Andre Giraud, France's minister of industry, announced in Paris on 11 December 1980. Participating in a colloquy on district heating, Andre Giraud indicated that this ambitious goal could also be reached through the burning of household garbage and waste and the use of geothermal technology. This systematic use of heat recuperation would make it possible to save imported fuels and should be one of the priorities of France's energy redeployment, according to the minister. In all, 12 billion francs in investments will be necessary for heavy equipment alone, which would additionally make it possible to create jobs. The sector most closely involved is that of urban heating, which makes it possible to render important networks profitable and to realize substantial savings. Indeed, the French people use 53 million TEP's each year for heating purposes of which 48.5 million TEP's are used in the residential and tertiary [services] sectors. [Text] [Paris AFP SCIENCES in French 18 Dec 80 p 41] 2662

COMPOSITE-MATERIAL WINDMILL ROTORS--The Aerospace Company is becoming involved in wind energy. On 18 December 1980, the National Industrial Aerospace Company (SNIAS) signed an agreement with the Aerowatt Company, a firm in which the AEC (Atomic Energy Commission) is the majority stockholder and which is the leading French firm in the field of windmills. According to the agreement, SNIAS puts its techniques and experience in composite materials to work by supplying blades for rotors 18 meters in diameter (generating a nominal power of 100 kilowatts). Joint studies are planned in other areas of power production, particularly with systems that generate 500 kilowatts. In the initial stage, techniques tested in the field of helicopter blades will be put to use in the production of makeup energy. [Text] [Paris AFP SCIENCES in French 1 Jan 81 p 26] 11,464

EC FUNDS FOR COAL CONVERSION--The European Commission has decided to grant additional aid amounting to 40.17 million accounting units for projects concerning with the liquefaction and gasification of coal. A total of 11 projects out of 23 proposed to the Commission has been chosen. They are for Belgium, France, the United Kingdom, the Federal Republic of Germany, Italy and Denmark. Criteria for the selection of projects include the diversification of both the solid fuels used and the products to be obtained. [Text] [Paris SCOOP ENERGIE in French 15 Dec 80 p 8] 11,464

CSO: 3102

WESTERN-WORLD HISTORY, USE OF INDUSTRIAL ROBOTS COMPARED

Paris LE NOUVEL AUTOMATISME in French Dec 80 pp 37-46

[Article by Claude Laurgeau*]

[Excerpts] Barely existent some 10 years ago, robotics is growing in the advanced industrial countries and is capturing the attention of their scientists and industrialists. A major revolution is taking shape in the field of production, under the sustaining influence of robotics. This article endeavors to present an overview of the current state of robotics and to define a number of basic concepts that tend to be confused owing to the rapid evolution of the art and the scarcity of feedback.

General Concepts in Robotics

Historical

The term automaton, of Greek origin (αυτομον), defines a machine that imitates the movements, the functions or the acts of an animate being. The term robot, on the contrary, comes from the Russian and renders the notion of work. Since antiquity, men have striven to build animated mechanical structures, by associating levers, pulleys, winches, screws, wedges, tubes, then later, springs, cams and simple hydraulic devices. Archimedes (287-212 B.C.) discovered his famous principle, calculated the number II, and invented the cam, the spring and the so-called Archimedes' screw. In 125 B.C., Hero of Alexandria wrote an initial treatise on pneumatics ["Pneumatica"]. With the Renaissance, technological advances (crank-and-connecting rod systems, clock mechanisms) led Leonardo da Vinci to construct an animated lion. Next came water-operated automatons which brought forth water-organs and animated bird scenes programed by sprocket drums. During the 18th century, the Frenchman Vaucanson became well known for his biomechanical devices: "The Flute Player," 1738; "The Duck," 1739. Automatons

* Professor at the University of Nantes, Laboratoire d'Automatique ERA 134, E.N.S.E.M. 1, rue de la Noe 44072 Nantes, France.

benefited from advances in Swiss watchmaking, but their sources of energy continued to be water, springs and weights, and their technology the association of mechanisms such as cogwheels, ratchet wheels, sprocket drums, and hypocycloidal or differential gearing.

These various highly ingenious devices, which achieved great successes in royal courts and in fairs, had entertainment as their sole purpose. The discovery and mastery of thermal and electric motors, and advances in pneumatic and hydraulic technologies, fueled the industrial revolution, the development of machinism, and mechanization. But it took until the 1960's to bring about the industrial use of robots in the current sense of robotics.

The Contemporary Era

The most advanced industrial countries in the field of robotics today are Japan, the United States, and Europe, particularly Sweden. The following chronologies regarding Japan and France illustrate the infancy and dynamism of robotics:

Japan:

1959 - Development of the first artificial hand

1967 - Formation of the biomechanics association

1970 - First industrial robotics exposition in Tokyo

1971 - Formation of the Japan Industrial Robot Association (JIRA) by 35 industrial builders

1977 - 7th ISIR (International Symposium on Industrial Robots) in Tokyo

1978 - Beginning of a 4-year national research program

In 1978, there were around 25,000 robots in service on production lines, with an annual growth rate of 6,000. There were over 100 makers of robots and some 300 researchers in basic robotics.

France:

1974 - Beginning of work on robotics at the Regie Renault

1976 - Beginning of action by the DGRST [General Delegation for Scientific and Technical Research] in the field of industrial robotics

1978 - Formation of the French Industrial Robot Association (AFRI), the counterpart the Japanese JIRA
Formation of an AFCET [expansion unknown] working party

1979 - Launching of a 4-year CNRS [National Center for Scientific Research] project: Advanced Automation and Industrial Robotics.

Preliminary Definitions: Manipulators, Automatons, Robots

In industrial data processing, distinctions are very faint and the possibilities of confusion very great with respect to the terms minicomputer, microcomputer, programable automaton, and microprocessor. The same confusions appear in industrial robotics with respect to the terms manipulators, industrial automatons, robots, loader arm, and certain special-purpose machines. We would like to propose the following unambiguous definitions of the principal concepts:

Manipulator:

A polyarticulated, multifunctional mechanical system capable of assisting man in carrying out operations in a hostile environment (nuclear, space, submarine environments, ironworks, foundries) or of compensation for a human handicap (prosthetics). A manipulator imitates the motions of a human operator or carries out his or her intent (prostheses or guided mobile devices), amplifying, as required, the applied effort, and sometimes reinstituting the repetition of the effort.

Industrial Automaton:

A manipulator that performs repetitive manual tasks (painting, welding, materials-handling, loading and unloading, assembly...) in a fixed and orderly environment, and whose motions, carried out in accordance with data that has been stored in a memory during a prior teaching cycle, are repeated in a cyclical manner. It is an open-loop-controlled system. One of its essential characteristics must be its ease of adaptability to diverse tasks.

Industrial Robot:

An industrial automaton equipped with video, audio, proximity-detection, tactile and other type sensors, that is capable of integrating at the control level its "artificial intelligence" sensings, of taking into account, at least to some extent, changes in its environment, and of making real-time decisions as a function of the resulting context.

Industrial Robotics:

All the disciplines, research, development and exploitation of manipulators and industrial automatons and robots.

It should be pointed out that the manipulators that have been developed since 1945 have been mainly for use in the nuclear industry, except for the power-amplifying manipulators (the prototype of which is the Andromat), which are improved versions of civil engineering hydraulic devices (cranes, tractor shovels). Industrial automatons may be divided into two very distinct categories: sequentially controlled materials-handling arms, frequently embodying pneumatic technology and

designated as "pick and place" by the Americans, and automatons having their various degrees of freedom position-monitored and sometimes velocity-monitored, and capable of repeating complex patterns of movement. The latter are designated "play back" by the Americans.

Of the automatons in service throughout the world, 60 to 70 percent are of the "pick and place" type--phase-locked automatons used for painting, welding, assembly...--and represent the current state of the art in industrial robotics. Robots, such as we have defined them and which characterize intelligent robotics, are still in the laboratory stage and practically nonexistent in industry.

It may be noted that up to and including the generation of the industrial automaton, machines have been basically progra able sequential or position- and velocity-monitored, multiple-axis mechanizations. Robots, on the contrary, introduce a new dimension, collecting, by way of sensors, data that are no longer solely in Boolean or analog forms, but in matrix form through video and tactile sensing. New disciplines such as recognition of shapes, artificial intelligence, and scene analysis are now being added to automation.

Some General Problems Connected with Robotics

Main Sectors of Robotics Use

In 1978, 25,000 were in service in Japan. Figure 9 shows that most of these robots were actually materials-handling arms or robots of the "pick and place" type. An examination of 3 consecutive years, however, shows a drop in the percentage of these lower-range machines, in favor of manipulators or remote manipulators and of industrial automatons (playback robots), the percentage of which nevertheless remains almost negligible (5 percent in 1978). Intelligent robots made no significant appearance until 1978.

Key:

A. Manipulators.
B. Fixed(B1)- or variable(B2)-sequence robots.
C. Industrial automatons (playback robots).
D. Intelligent Robots.

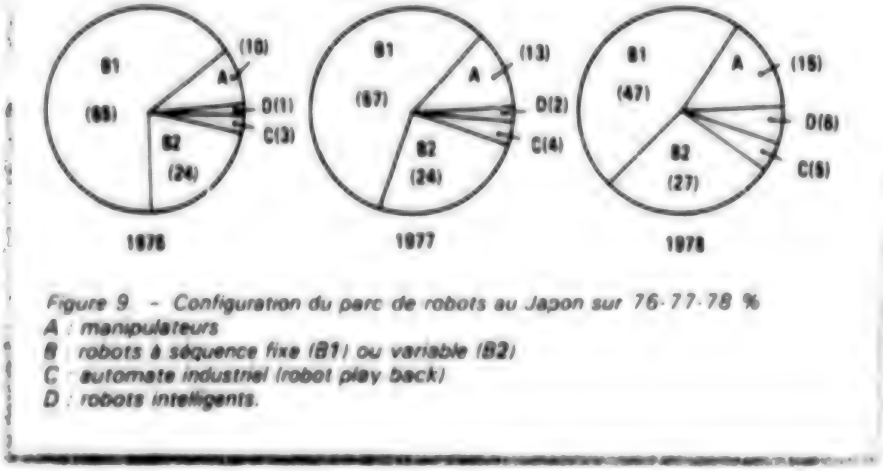


Figure 9 - Configuration du parc de robots au Japon sur 76-77-78 %
A : manipulateurs
B : robots à séquence fixe (B1) ou variable (B2)
C : automate industriel (robot play back)
D : robots intelligents.

Fig 9 - Percentage configuration of robots in service in Japan in 1976, 1977, 1978.

The sector of use of the remote manipulators was fairly well confined to the three domains hostile to humans: the nuclear environment for the handling of radioactive substances (or intervention in contaminated environments), the submarine environment for the drilling of boreholes, the installation of pipelines, exploration for nodules, the space environment with remote-controlled experiments on the moon, and soon, platform assembly operations in space. Manipulators assist humans in activities requiring dexterity and power. They are sophisticated versions of civil engineering hydraulic devices (for use in foundries, ironworks, steelworks, etc).

Pick-and-place type robots are being used to handle all sorts of components, to feed digital-controlled machine tools, to transfer work from work station to work station, and to load and unload special-purpose machines.

Industrial automatons (or playback robots) have found application mainly in painting, welding, de-burring, grinding and polishing, assemblage, and checking operations, and in torch-, laser-, and hydraulic jet-cutting operations.

The intelligent robot's principal niche is assembly, which remains the major problem in unautomated production. Many applications requiring recognition of shapes, checking of paper currency, of signatures and of objects, automatic reading of typewritten material... are already current, but they cannot be considered to be based on robotics unless they react on the operation of a mechanical structure.

If we view the industrial sectors using robotics, we find automobile manufacture at the head of the list (approximately 35 percent), followed by electrical industries (approximately 25 percent), the plastics industry (approximately 10 percent), mechanical industries (approximately 8 percent) and lastly, others (Figure 10).

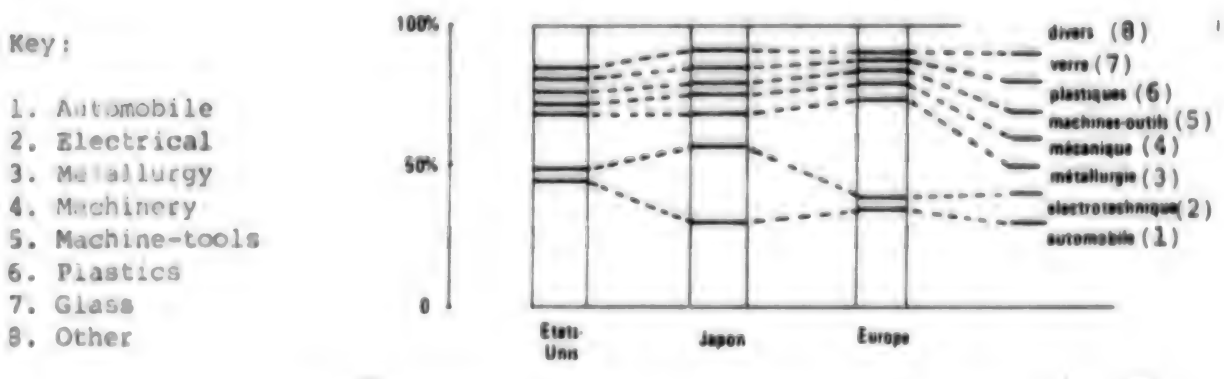
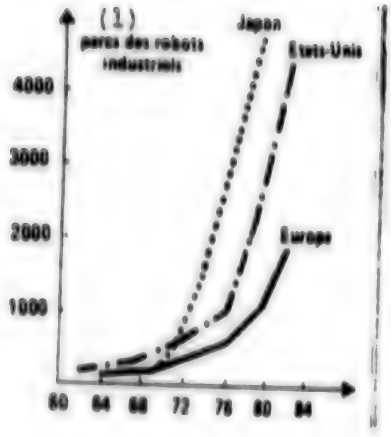


Fig 10 - Distribution of units in service by industrial sectors.



Key:

1. Industrial robots in service.

Fig 11 - Advanced robots in service in major industrial countries.

Key:

1. Sweden.
2. Italy.
3. Federal Republic of Germany.
4. Great Britain.
5. Others.

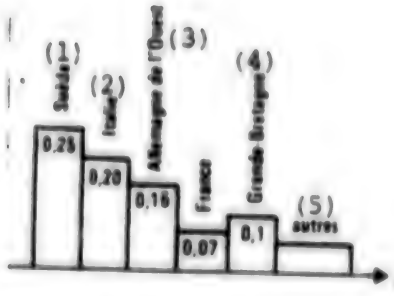


Fig 12 - Distribution of European robots in service in 1974.

A survey conducted in Japan to determine the reasons for the introduction of robots in industry yielded the following findings:

Economy of labor	44.5 percent
Improvement of working conditions	25 "
Increased flexibility of production tooling	13.5 "
Improved inspection of production	8 "
Other	9 "

Major 'Robotized' Countries - Principal Makers

Under the expression "robotized countries," a distinction must be drawn between penetration of robotics at the production level and the state of technical advancement of robotics.

As regards the industrialization of robotics, there is no question that Japan leads the United States (Figure 11) and that Europe is underequipped despite the relatively good positions of Sweden, Italy and the FRG (Figure 12). France, having started late (the start of robotics at the Regie Renault dates back only to 1974), is slowly catching up as regards equipment, but it appears that, at the research level, the French position in advanced robotics is not unfavorable.

We give herewith, for the major industrial nations, a list of makers of robots, which is neither an exhaustive one nor a listing in any particular order:

Japan: Hitachi, Kawasaki, Mitsubishi, Kimatsu, Nissan, Seiko.

United States: Unimation, AMF, General Electric, Cincinnati, Milacron, Andromat.

Sweden: Asea.

Italy: Fiat, Olivetti.

FRG: Volkswagen, Siemens, Bosh.

Scandinavia: Electrolux.

France: Acma Renault, La Calhene, Languepin, AOIP [Precision Instrument Workers Association], CERCI [expansion unknown].

From Robotics to the Adaptive Shop

Numerous other aspects of robotics will not be examined in this brief report, and particularly its social and economic consequences, and its axes of basic research. A May 1975 Frost and Sullivan report concerning France finds that, to maintain a constant level of productivity, 300,000 additional unskilled workers must be found each year. The demands of productivity, economic competition, and social demands for improved working conditions are the factors that will speed up the

robotization of production. This aspect of robotics, however, has to do with the automation of materials-handling operations. The substitution of pick-and-place or playback robots for unskilled workers is, in the final analysis, but a very rudimentary application of robotics. The future of intelligent robotics depends upon the resolution of far more complex fundamental scientific problems, such as the recognition of three-dimensional shapes, the recognition and synthesis of the spoken word in real time, spatial video, tactile sensing, the working out of plans of action, and cooperation between robots. The putting in place of such an advanced technology will have to be found economically viable and relevant. For instance, false problems are sometimes being resolved, such as: recognition of various objects for the purpose of sorting them, when it would suffice, during the industrial process, not to mix them in the first place; recognition of the balancing side and gripping points of a part, when the part could be prepositioned by conventional means. Instead, the computerization of the various phases of industrial production; data processing in the design department by means of CAO [expansion unknown]; computerization in the methods department for the working out of operating ranges and plans for utilization of machines; computerization of shops by means of CNMO [expansion unknown]; computerizarion of production management; programable automatons for special-purpose machines; advanced robotics--these are the various elements the judicious juxtaposition of which will give substance to the concept of the "adaptive shop."

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9399
CSO: 3102

AFP SUMMARIZES RESULTS OF RECENT POLL ON ROBOTICS

Paris AFP SCIENCES in French 8 Jan 81 p 20

[Text] Paris--Automation in France and in the World

Automation is still developing slowly in France, particularly in the small and medium-size industries. The magazine "Industries et Techniques," which has devoted a special issue to automation, has published a survey of 600 companies with less than 500 employees: 6 out of 10 of these companies do not even have automated machines. Computer-controlled production is very low (1 percent), as is the use of programmable robots (1 percent). Purchase plans for such equipment in 1981 and for the medium term are modest.

As regards robots--if we consider the industrial sector as a whole--of the 18,500 robots of record in the world in 1979, 8,900 were to be found in Japan, about 3,000 in the United States and 500 in France.

However, as is shown in an article devoted to Japan this month, the Japanese company Jutitsu Fanuc is to inaugurate a new and highly automated plant at the foot of Mount Fuji in which only 80 persons will be employed to produce 350 robots per month.

In France, about 100 researchers are studying robotics and its related techniques within the context of the advanced automation and robotics program (ARA). The project, which has just got underway, should result in a series of developments in the industrial sector in 1983.

Another interesting finding of the survey published in the magazine, which was conducted by the French Public Survey Institute, deals with the attitude of public at large toward automation. As a whole, the public is not really opposed to automation but fears that it will cause unemployment. Some 58 percent of those interviewed think that automation will bring about a large increase in unemployment; 31 percent with resignation say: "You cannot stand in the way of progress;" 29 percent feel that it will make people slaves of the machine. One out of five stressed the fact that automation will permit an improvement in working conditions.

This special issue of "Industries et Techniques" published an interview with the minister of industry, Andre Giraud, for whom automation is not only desirable but necessary. He recalled that on 8 December the president of the republic announced that 1 billion francs in government-backed [bonifies] loans will be used for the financing of robotic equipment.

8143
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AUTOMATION EXPERT DISCUSSES FRG'S PREEMINENCE

Paris INDUSTRIES ET TECHNIQUES in French 31 Dec 80 pp 126-128

[Interview with Dr Hans-Jurgen Warnecke, director of the Fraunhofer Institute for Production Techniques and Automation, by Jean Deflacliere, Frederik Reitz and Wolgang Lotte; date and place not given. Passages enclosed in slantlines originally printed in boldface.]

[Text] Germany is on a par with the United States and Japan. That is the unequivocal opinion of Doctor-Engineer Hans-Jurgen Warnecke, the director for 10 years of the Fraunhofer Institute for Production Techniques and Automation (Stuttgart). At the center of the most advanced research in this sector, he is considered the German automation expert. He confided his country's "secret" to us: its preeminence in the machine tool field. However, behind the optimism of his words, we also discern serious concerns about a competitiveness which is threatened by the weakness of the electronic components industry, the obsolescence of production equipment and the high cost of machines.

[IT] Where would you place German industry in the world automation race?

[Answer] I would say that our level of automation is equal to that of the United States and the other Western countries. I even feel that, from an entirely general standpoint, Germany is at the head of the pack. As for Japan, it is only slightly ahead of us and in only a few sectors.

[Question] How do you explain this favorable situation?

[Answer] Except for electronic components, /we have in our country all the means necessary for the development of automation/. Our principal ace in the hole, in my opinion, derives from the manufacture of machine tools, special-purpose equipment and assembly installations. If you add to that the delivery of turnkey plants, you have about 50 percent of the production which we are able to export. To cite only the United States, it is clearly better positioned in this decisive sector.

In spite of a several-year shortfall compared to big industry, our small and medium-size industries are already quite automated, with /advanced utilization of sequence control/. Of course, that presupposes good organizational capabilities. On the other hand, if you take a look at American and Japanese small companies, you will find that most of them are rather poorly endowed with modern equipment.

In this connection, microcomputerization of the worksite will offer additional possibilities to small and medium-size industries. The operator who is responsible for one or several machines will, in fact, be able to program their cycle, in his work area, instead of calling upon specialized programming services.

[Question] In which sectors is automation most widespread?

[Answer] The biggest user without question is /the automobile industry/. Next comes the electrotechnical and mechanical construction industries. Not to mention the textile sector in which Germany has regained a high position.

/In the producer sector/, we should mention first and foremost electrotechnical firms such as Bosch and Siemens, IBM-Germany and the principal manufacturers of machine tools. However, in addition to these giants, many companies have been organized to expliot one or two original ideas. Finally, other companies see an opportunity for diversification in these techniques. For example, I am thinking of two innovations in the servomechanisms market: Jung Heinrich, a maintenance expert, and the Friedrichschaffen cogwheel and gear plant.

[Question] Do you also see any weak points?

[Answer] Doubtless we are suffering from the weakness in our /electronic components/ industry. We have to import a large part of our component supplies from the USA, and I fear that Japan will become an even greater threat in this sector. Only these countries have big enough markets for this production to be competitive. Unfortunately, Europe has not been able to establish an industrial power of that dimension. As in the past, Europe continues to be divided by its national differences; and that is harmful to our development.

For the moment, we are somewhat behind Japan in the automobile industry. We are even in danger of falling behind with respect to the Americans who are investing a lot of money. However, German producers have learned a lesson from this and are devoting much greater resources to automation than in the 1970's.

Even though they continue to have an excellent position in international competition, /our machines are too costly/ and owe their success only to their technical superiority and their reputation for reliability. I think the prices now being charged in the FRG are apt to cause us /to lose markets to/ countries which are advancing rapidly such as /Italy and France/.

What is more, statistics have shown the serious obsolescence of our own production apparatus. The average age of our equipment is probably over 13 years which, to me, seems quite prejudicial to competitiveness.

We are also encountering problems in small series production. However, that is not trictly a German phenomenon; it is a general industrial problem which we are attempting to solve by an even greater level of automation.

[Question] Does this superior level correspond to what we in France call flexible workshops?

[Answer] If by flexible workshop you mean a plant without personnel, without human beings, then I will say no. There are no plants of this kind, and there probably never will be! But there are highly automated worksites where the work is done with very little manpower participation. That is the case of /Messerschmitt/ (MBB [Messerschmitt-Bolkow-Blohm]) which has installed a plant /in Augsbourg/ in which practically no one participates in production per se. However, some of the workers have been transferred to other jobs: preparation of tools, surveillance over the manufacturing process, data collection, information processing... MBB is the typical example of a small series production plant. Automation is not profitable here except through operation of the machines 24 hours a day. In reality you will find most automated industries in the mass production sector.

[Question] On the basis of what criteria do you decide to automate or not automate a plant?

[Answer] During the past few years, we have automated a manufacturing process without making it more profitable. That was done either /to free men/ from their monotonous or dangerous activities or /to assure product quality/. However, in general the decision is based /above all on profitability/, that is on the comparison between manpower-costs and machine-costs.

Equipment costs are almost too high to be amortized during an 8-hour workday. Therefore, it is likely we will most often be forced to automate rather completely so that the installations can operate on their own for three 8-hour shifts.

We also recognize the fact that some phases of manufacture or certain operations are not automatable or are automatable with difficulty or at great cost. In such cases, it would be better to leave them to men.

Thanks to our ability to have real time dialogue with the computer, on the production site, we will be able to go as far with automation as is really judicious. And the operator will take care of the rest: everything that he is able to do or decide better or more quickly than the machine.

[Question] Would you please serve as our guide in a tour of a plant worksite by worksite?

[Answer] /We have gone the furthest in the manufacturing sector/. We are also well along in the treatment of surfaces, galvanization and painting. We are getting good results in the materials movement sector. Storage and maintenance also are worthy of mention. As are the foundry and stamping sectors.

On the other hand, in the forging area, we are just getting started. Quality control is one of our prime hang-ups. And /the assembly delay/ should disappear as soon as we find more rapid and more precise scanners and manipulators on the market. In a.. likelihood around 1985.

[Question] What progress do you anticipate?

[Answer] If we utilize the facilities offered by microprocessors and text handling systems, progress will first be made in the sectors of /assembly, production management/ and /administration/ [bureautique]. Automation of maintenance and materials movement is also to be expanded.

Paralleling the development of equipment, that of information will experience a similarly evolution toward increasingly advanced integration and automation, from engineering to the automatic operation of machines and quality control. (CFAO [computer assisted conceptualization and manufacture].)

[Question] In what way is your institute competing in those sectors?

[Answer] We are working in four principal areas. Our /research/ is first and foremost on /optical and tactile scanners/ which are designed to imitate the senses used by man in assembly. Next we are studying the question of /movement of materials/, in relation to flexible worksites. I must also mention our projects involving the CFAO process. Finally, in the quality control sector, we are developing a programmable measuring apparatus.

[Question] In what way is the state encouraging research?

[Answer] The federal government is concerned about the decrease in the competitiveness of our industry. It is not skimping on assistance to remedy the situation. Thus, 4 years ago, it initiated /operation calculation/ which ends today. In spite of our progress, we still have not entirely caught up with the Americans in the manufacture of computers and text handling. Such research is now passing from the theoretical stage to that of applications. Industry will take over from the university and will benefit from state assistance.

Other subsidies are being granted in order of priority to /servomechanization/, manipulation techniques and flexible worksites. I also think it worth emphasizing that research in our country is benefiting from close cooperation between manufacturers and their customers. In the case of the automobile, for example, the biggest users of automated equipment are themselves studying manufacturing processes which they then develop jointly with the producers.

[Question] To conclude, what are your feelings about the social repercussions of automation?

[Answer] Up to now, the /trade unions have reacted positively/. They have always understood the direct relationship between automation on the one hand and wage increases, a decrease in the hours of work and improved working conditions on the other hand.

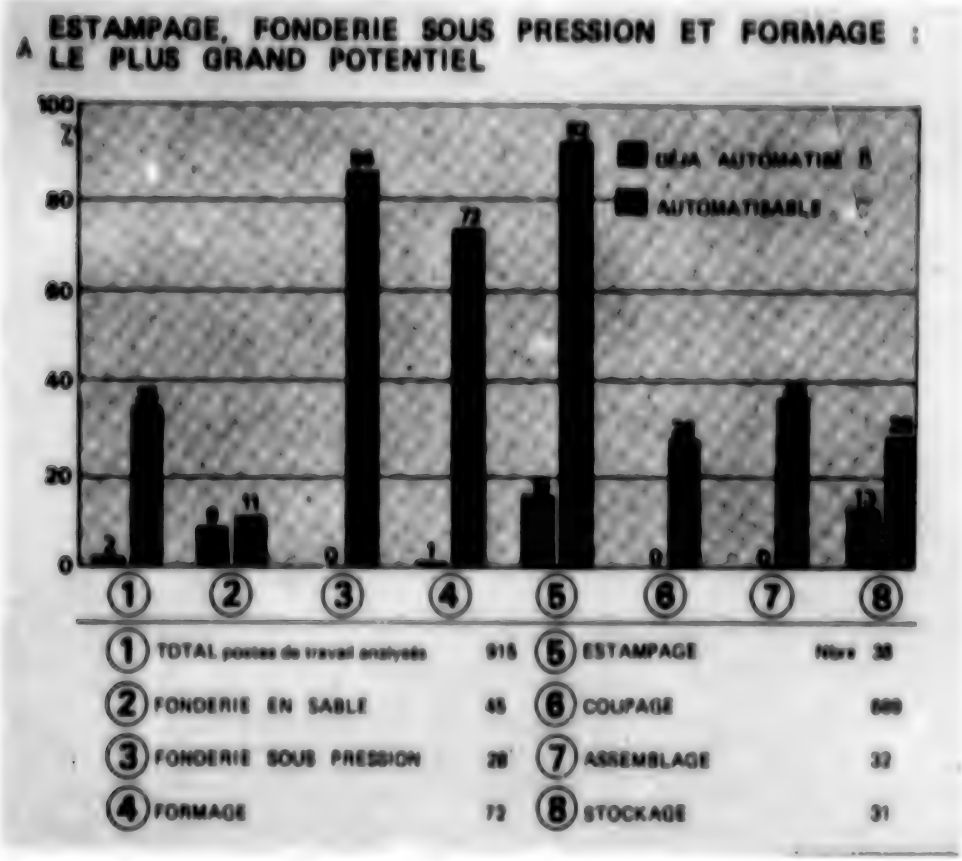
Employment problems are in danger of increasing when the tertiary sector, which is also automating very rapidly, is no longer able to absorb the manpower released by industry. However, I think that with competitiveness increased by automation measures, we should be able to increase our exports, draw greater growth therefrom and, therefore, resolve these problems.

Fraunhafer Institute for Production Techniques and Automation

Breakdown of 649 servomechanisms in the FRG in August 1979.

Key:

1. Manipulation, Welding and Storage: Over Half the Servomechanisms
2. Manipulation of Tools
3. Storage
4. Spot welding
5. Arc welding
6. Burr removal
7. Others
8. Stampings
9. Forging
10. Bessemer process
11. Injection smelting
12. Multiple manipulation
13. Assembly
14. Research
15. Other
16. Manipulation of Pieces



Key:

A. Stamping, Bessemer smelting and shaping
B. Already automated
C. Automatable
1. Total worksites analyzed
2. Sand casting
3. Bessemer smelting
4. Shaping
5. Stamping
6. Cutting
7. Assembly
8. Storage

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RENAULT FLEXIBLE WORKSHOP TO BE OPERATIONAL BY JUNE 1981

Paris INDUSTRIES ET TECHNIQUES in French 31 Dec 80 pp 167-170

[Article by Alain Perez. Passages in slantlines originally appeared in boldface]

[Text] A truly flexible workshop must have the capability of simultaneously processing various production pieces and in real time providing direction for all the manufacturing processes with overall servocontrol of production. At present, such a workshop does not exist. Renault is in the process of building one and is inclined to believe that it will be the best. The system developed for the Renault industrial vehicles plant [RVI]--the first client--will be operational in June 1981. Boutheon will be a truly flexible and coherent production system.

Today machines are very flexible and very productive. The movement of production pieces is adapted to computerized management, and the computerized tool has been developed. Everything is not perfect; however, product stability and sufficient industrial might have now been attained. A flexible system today permits an important reduction of production /costs/ and /increases the usage rate of machines/ (effective work time compared to total time) /by a factor of two to four/, according to application.

The Boutheon RVI workshop, near St-Etienne, which is being built, has 10 unloading stations. Its production capacity is between five and 30 production pieces per hour for an average period per operation of 3 to 5 minutes. In this system, which will operate initially on two 8-hour shifts and later on three 8-hour shifts, only the pallet-loading process is manual. Four persons will be employed, one for loading, one for the adjustment of the tools, one for miscellaneous assistance and the fourth for surveillance of the computer. With production of 200 to 250 production pieces per day broken down into 10 families, Boutheon is considered a medium-size series production workshop with medium diversification. These facts and figures are secondary to what is concealed behind them.

All of the mechanical elements of a workship of this kind today have reliability levels which are quite comparable and which make them susceptible of use on a mass production line without risks. It is possible to build remote-controlled, self-propelled carts, automated modular machines, production centers or servocontrolled roller conveyors. On the other hand, there is less mastery over measurement and information collection--scanners are still poorly adapted to the industrial sector--with respect to the elements of production and movement of materials. But the /real problem is the processing of all these data in real time/, establishing flexible

production flowcharts and integrating possible breakdowns into the program. In particular it is necessary to simulate the overall operation to determine the number of carts required and make decisions with respect to the location of pallet areas. With optimization accomplished for a specific production process, it is then possible to move on to the stage of managing the entire complex.

The problem is not an easy one. Knowing how /to conceptualize and run/ a workshop of this kind demands /mathematical techniques which do not exist/. The Cincinnati project is programmed, but does not really have a guidance system. Renault's secret, therefore, is not in equipments but in the program, the simulation of production flowcharts. At the Renault machine tool plant, one will no longer say: "There are too many people working on this matter, and there is complete silence about what is really being done in Japan and the United States. And at this time, ideas are what count."

However, ideas are not all born at Renault. Regie has called upon several teams of university researchers. The Toulouse Center for Studies and Research (CERT) has developed the initial simulation program. The Grenoble Institute of Applied Mathematics (IMAG) has worked on the automatic generation of production flowcharts and the LAMSAD (Laboratory for Analysis and the Preparation of Models of Systems to Aid in Decision-Making) of Paris IX-Dauphine had studied the programming and automatic operation of the entire production process. That was not just by chance. The Renault machine tool plant is also responsible for the ARA (Automation and Advanced Servomechanization) national program of flexible workshops sector which is directed by the CNRS [National Center for Sceintific Research]. "Research on flexible workshops cannot be conducted without industrial support."

Therefore, it is necessary /to distribute the production pieces/ (transmission gearbox components) when /needed as a function of the availability of machines/, /the degree of urgency/ and the /compatibility of operations/. The number of possible sequences is considerable and a computer simulation was necessary to optimize the use of equipment and control the movement of carts and the flow of production pieces.

A program developed under contract with the CERT [Center for Technical Studies and Research] by J.-B. Cavaille and J. Delmas, of the Department for Study and Research on Servomechanisms (DERA), has been operational since the beginning of the year. It reproduces and visualizes the movement of the carts and the schematized operation of the machines, thus giving a veritable dynamic representation of the workshop. The envisioning of all cases of conflicts being impossible, only long-term simulation permits the resolution of these problems. Theoretically, all cases involving figures can be simulated. It is enough to allow the program to run and wait for...a blockage. At the outset, it held for a minute. Now it is thought that there is a sufficient level of reliability. Developed in accordance with Renault's specifications and adapted by Regie to its own needs (which in particular included the period of time the machine is operational) it can easily be adapted to even larger workshops.

The system also has a possibility-of-breakdown generator which is capable of introducing either frequent and short shutdowns (less than 5 minutes) or long but less frequent shutdowns (30 minutes). Three kinds of output are provided for: display tube layout (production by piece) and statistical (rate of usage of machines). The visual check operation speeds up the process four-fold. On the computer, a 16-hour workday is run off in 1 minute 30 seconds. Accelerated simulation is a major tool for the validation of the Renault system.

The second essential point involves the /automatic generation of production flowcharts/. In a conventional system, /one/ flowchart represents /one/ production piece as a function of the experience of each company's programmers. At the IMAG, there has been a rethinking of the problem with the introduction of flexibility of decision. The originality consists in imagining an entire family of flowcharts for a given production piece. This system which has been named GARI is at present able to generate simple flowcharts. It consists of three data bases: the company's inventory of machines (generally stable in time), the technological standards proper to the company (it is preferred to have one operation carried out before another) and the description of the piece to be produced.

Production operations are portrayed by technological symbols in which each removal of material is represented by a volume indicator (hole, strip, groove, etc.) which avoids a detailed description. These symbols are characterized and connected by dimensional and geometric indicators. This visual conception of the production piece in which one defines volumes rather than faces is, for the moment, limited to orthomorphic solids (in which the axes are either perpendicular or parallel). This conception leads to flowcharts in which everything is not absolutely decided except for the faces of reference. Another advantage, the representation of the solid on the screen is easier. GARI now has /50 technological standards/ (200 are required) and /10 levels of priority/ to resolve conflicts between two contradictory orders (four or five should be enough). In this way, the program permits postponement until the last moment of the choice of operation to be effected. According to F. Latombe, the official in charge of this study at the IMAG, and Mr Descottes, who has developed flexible flowcharts, "To conceive a flexible workshop, we must know the kind of production piece which is to be manufactured. The type of tool which was developed in Genoble could contribute to flexibility; however, it is not indispensable." At Renault, the automatic generation of flowcharts is considered of capital importance. In the selfsame opinion of experts: /"The operation of a flexible workshop is very difficult on the theoretical level, and that has never been done."/ A key point in the total picture has been touched upon. It is also the most secret. This time, the Renault machine tools plant called upon the team of B. Roy of LAMSAD. Within this group of Paris IX researchers, Catherine Dupont has in particular distinguished herself and has been offered (and has accepted) a position as scientific adviser of the RMO [Renault machine tools] plant. "She brought us something new, thanks to a new, nonanalytic approach."

The servocontrol system must continually control all the operations and all the unknowns of production and have its own capability of reacting to disruptions. It must also group the maximum number of operations and minimize the movement of production pieces. It must,therefore, when a machine is at the point of availability, seek out the next production piece, with account taken of the degree of urgency, compatibility of operations, traffic conditions and the possibilities of breakdowns of one of the elements of the machine or cart. The emission of this signal sets in operation an algorithm to search for the most desirable production piece. All of this is done with a commercial computer. Bouthen will use a Solar computer. Simulations at the CERT and LAMSAD have been made with an IBM 360. The program developed by Catherine Dupont is now the subject of a thesis. This program was also subjected to simulation tests before validation. It is adapted to systems with one input and one output; therefore, it cannot be used directly for flexible assembly workshops. It required 1 1/2 years of full-time work by its creator.

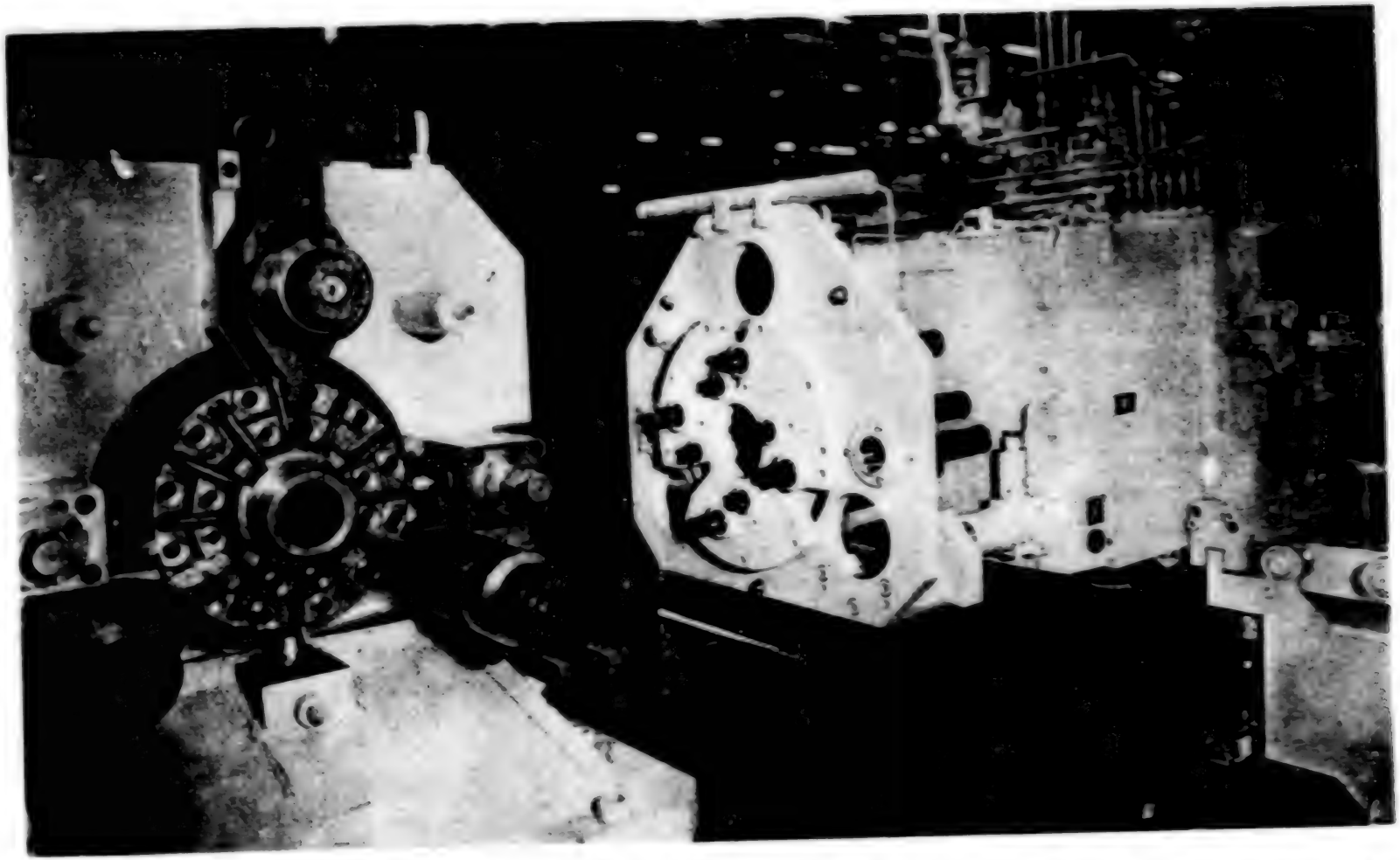
/Everything, therefore, seems to be resolved by this class of workshop (production and movement/ of pieces by self-propelled carts or overhead conveyors). So simply resolved that the logic does not frighten the client, and that poses a few problems of protection. C. Dupont will continue to adapt her program to future systems on behalf of RMO while remaining a CNRS researcher.

RMO has, therefore, set a very high standard for its first client RVI, which is privileged, it is true: the Boutheon workshop will begin operations on 1 June and there will be a progressive increase in its rate of operation. Other systems are already being studied in France, in the bordering countries.

Boutheon was not set up for pleasure: Renault will sell flexible workshops to anyone who wants to buy one from it, without discrimination. It will supply a complete system which will have the capability of making one production piece and carrying out an entire production process. Renault is quite surprised by the reception it has had and by the importance of the projects which have been submitted to it. The requirements are very well formulated by the clients.

After a few years of Japanese euphoria, we have arrived at the hour of Renault. Is this really a technological watershed which is not to be missed? Difficult to say--the cost of the operation continues to be a mystery--but that is what it appears to be.

At Regie, they are already looking further ahead. A flexible transmission assembly workshop system is now being studied. It will use robots to automatically grasp pieces.



p. 167: Convertible modular machines (MMC) have been in existence for 5 years. The working heads are mobile.

p 169: The self-propelled cart at the Renault flexible workshop. Controlled by wire, the cart was conceived by the affiliate SEIV [expansion unknwon] for the movement of production pieces.

8143
CSO: 3102

MACHINE TOOL MAKERS PLAN JOINT MARKETING EFFORT

Paris LE NOUVEL AUTOMATISME in French Oct-Nov 80 p 8

[Text] Meeting in Vienna (Austria) for the 13th time, 14-17 September, Western European machine tool makers, who represent 220,000 wage earners, attached very special importance to the means of tackling the especially difficult conditions of world trade.

For the first time, the member countries of CECIMO (European Committee of Cooperation for Machine Tools) are going to attack jointly the markets outside Europe in the course of a series of exhibitions. The first of these exhibits, entitled EMTO (European Machine Tool Overseas), will be held in Seoul (South Korea) 5-11 March 1981. Other markets have been studied and, among these, Mexico has been chosen for 1983 and the People's Republic of China for a later date.

In addition, the delegations emphasized the necessity of fostering a greater awareness of the vital role played by Western European machine tool companies. To this end, CECIMO is going to inaugurate a campaign intended to more clearly identify the range of products manufactured by member countries with full information about technical innovations, design, price level, quality and reliability. This campaign will be based on the reputation acquired by CECIMO members, to which they remain resolutely attached.

Preparation for the next European machine tool exhibition, with worldwide participation, sponsored by CECIMO (the 4th EMO), which will be held in Hanover 15-24 September 1981, is continuing.

The 4th EMO will take place in Hanover 15-24 September 1981. It promises to be very important. French participation will be organized by the French Machine Tool Builders Union [Syndicat des Constructeurs Francais de Machines-Outils] (SCFMO), 150 Boulevard Bineau 92200 Neuilly-sur-Seine.

9330
CSO: 3102

FIRST FLEXIBLE WORKSHOP TO FUNCTION IN 1981

Paris LE NOUVEL AUTOMATISME in French Dec 80 p 15

[Text] "Renault Vehicules Industriels" are preparing an experimental flexible workshop. It will be the first flexible workshop which will operate in France, starting in 1981. It will manufacture heavy truck transmissions in the Renault Vehicules Industriels factory in Venissieux.

This type of workshop reflects the preoccupation of enterprise managers with improving the utilization of their production machinery. This imples the mastery and availability of the means of manufacture and automation. Now the latter still only governs 10 percent of sequential automatic devices used in the engineering industry, which demonstrates the great lag of this branch. Its inertia is well known, for it took 15 years for digital control to make a breakthrough in this field.

The principal reason for this lies probably with investment problems which should be reexamined so as to make it possible for a greater number of workshops to modernize in order to remain competitive. It is known in fact that large enterprises obtain credits a lot easier than small enterprises.

Assuming that this problem will be solved, in the years ahead Renault could play a counselling role regarding flexible workshops, in addition to that of supplier of material. The counselling would concern the setting up of workshops, the use of all-purpose robots for loading and unloading machines, and the supply of appropriate logicial.

Let us mention that Japan leads with 60 to 100 flexible workshops, followed by the United States (10 to 20), the German Federal Republic (around 10), the German Democratic Republic (5) and Sweden (4).

9330
CSO: 3102

SCIENCE POLICY

DELAPALME INTERVIEW: HOW TO IMPROVE RESEARCH IN FRANCE

Paris L'USINE NOUVELLE in French Jan 81 pp 6-8

[Interview with Bernard Delapalme, director of scientific and technical research of the ELF-Aquitaine national company, by Dominique Boudet; date and place not given]

[Text] In France, Bernard Delapalme is one of the men most familiar with the strengths and weaknesses of our research system. Director of scientific and technical research of the ELF-Aquitaine national company, president of the Innovation Mission of the Ministry of Industry and of the Secretariat of State for Research and up to a few months ago president of the ANRT [National Association for Technical Research], he presented a report last year on the subject: "Technological Change and Economic Policy," the culmination of 2 years of work by an OECD group of experts. Therefore, his experience qualifies him to properly establish the order of priorities. And to say--with a frankness which characterizes the interview he granted L'USINE NOUVELLE--to researchers and company officials that improvement of research in France also calls their own behavior into question again.

L'USINE NOUVELLE: Is there a crisis in research in the Western countries and is it greater in France than elsewhere?

Bernard Delapalme: My views on that subject are quite different from those which are in vogue at this time. In fact, if by "crisis" you mean "critical inadequacy," I will say that there is no crisis. Of course, there is indeed inadequacy of research in France, as elsewhere in most of the countries of the world; however, that inadequacy is not critical. The most important problem is not the amount of research but its organization. Improvement of the utilization of the scientific, technical and technological research potential--that is the capital problem. I strongly emphasize the three terms, although others only talk of the first of these, scientific research. The White Paper in particular is almost exclusively devoted to it. But science cannot be an end in itself because of all the expenses it entails.

UN: When you say the research problem is not one of money, that, in fact, is a rather surprising view.

BD: Hold on! I did not say that research does not need money. I said that the most important point was improvement of its organization. If we are to develop an organization, we must give it supplementary funds. If, therefore, we wish to give priority to research--I am very definite on that subject--we must give it money. On the other hand, we should require the beneficiaries to organize in such a manner as to properly carry out their mission.

UN: With respect to scientific research, what is more important to set right, the budget or the organization?

BD: Great progress has been made; however, people are not always aware of it. Recently, I heard an eminent researcher say before a large audience that it is more difficult today for a young researcher to carry on independent research than it was in his own early days, 25 years ago. That is patently false. The present CNRS [National Center for Scientific Research] budget is 4 billion francs. How much was it 20 years ago? And how many young people can engage in research through the auspices of the CNRS, university scholarships, etc?

UN: Well then, in your opinion, what is the most important problem in the scientific research sector?

BD: The poor integration of the scientific community into the country as a whole. There are still many researchers who think they have the right to engage in research but have no obligation to participate in national life. That is particularly true in the basic research area. I agree that a country should spend as much money as it can on basic research, but to entrust it to someone without sufficient intellectual level is not acceptable. We must financially encourage quality researchers and discourage the others.

UN: It will be difficult to get this compensation system adopted and even more difficult to implement it.

BD: It is true that the higher the level of researcher the more difficult it is to evaluate him. However, experience has shown that when we have discussions with university professors, they rarely have a problem naming men of quality.

UN: The second research sector is technical research. How do you see the situation in the technical research centers?

BD: There, too, neither their funding nor their organization is up to the mission which has been entrusted to them. However, this is very important: we must assure the connection between the scientific world and small and medium-size companies which do not have the means to keep up with what is going on in their sector. What is more, the budgetary share devoted to these centers, if I am not mistaken, is to be increased 1.7 percent. That is totally ridiculous in light of the size of the problem. If I were "God the Father," in this instance the Public Authorities, I would double the funds placed at the disposition of the technical centers. This would never be more than 3.4 percent. But I would use these funds to implement an entire new system which would make the French technical centers a model. Unfortunately, such is not the case at present. The Americans have just discovered the technical centers. One of the options President Carter selected in the very complex report which he called for from his administration consists in promoting technical centers in the United States. And to accomplish this, administration officials are going to investigate what the English are doing. Why not the French? "Because the organization of English technical centers," they reply, "is more satisfactory than yours." And I think they are right.

UN: What must we do?

BD: We must not resolve problems for other persons. We should gather all the concerned parties around a table, namely the professional trade unions, sponsors from the administration and people from the technical centers. There are several ideas circulating about the reorganization of the technical centers. These ideas per se do not seem necessarily bad, in my opinion. Except one, the one which consists in eliminating the state-levied [parafiscal] tax. I consider that it is entirely logical, when one buys a product, to pay a small percentage to insure the future of the industry in question, whereas if we asked the consumer to pay that amount voluntarily, as when the hat is passed, he would not do so. I know that the very principle of the state-levied tax is not favored by the Ministry of Finance. However, I think it is a good principle.

UN: Now let us talk about technology which, as you indicated at the outset, is the third sector.

BD: In the OECD report, technology is treated in a way that clearly shows what it really is: general technologies. This is a sector in which there is not enough interest. Basic researchers find that it is too applied for them, while engineers, on the contrary, find that it is not applied enough. Therefore, technology is situated between the two and consists, for example, of studying composite materials on a somewhat basic level. The scientists do not wish to become involved with anything other than pure materials. Because, when materials are not pure, things are so complicated that they are unable to find the laws which govern the materials. As for the engineers, they take a "device," determine whether it will maintain its shape, whether it is temperature resistant, take measurements and go no further. But there is a place for studies on aging, heat-retention qualities, problems of interface, etc, which are posed by most materials. Composite materials themselves are the product of general technologies. Just as robotics or biology, if we take the latter in a broad sense. When we speak of modern biology, everyone thinks genetic engineering. That is a mistake, for the biotechnology of the future is genetic engineering plus fermentation techniques, plus still other techniques. Industry cannot develop unless it masters the totality of these techniques. This is also a sector in which the English are taking great pains.

UN: Once again the English as an example! To say the least, the quality of their research is not to be found in their economy.

BD: Exactly right. The English devote a considerable part of their national product to research, have one of the best organized research sectors, and win a very large number of Nobel prizes. And, yet, their economy is falling apart. That is because research is worth nothing unless it is placed in a general context which permits its being taken all the way to the end. Research is not of interest per se but as an important part of the innovation cycle. In turn, innovation is only of interest to me to the degree that it permits me to bring advantages to my fellow citizens. I have attempted to prepare a summary classification of the principal countries from three standpoints: their scientific and technical potential, the position occupied by scientists (researchers, engineers, technicians) and the people's receptivity to innovation. You can have a country with a good research potential in which "technologists" are considered as persons of quality and in which it is the "administrators" who are in charge and who are opposed to the risk associated with technology. As for innovation, that is just what it is: the willingness of the whole country to do new things with the risks attached thereto.

UN: In each of the three sectors indicated what is the situation of the French?

BD: As regards scientific and technical potential, it seems to me that we are at a lower level than the Americans but at the same level as the Germans and Japanese. The technological potential of the Germans and Japanese is not superior to our own and is probably a bit inferior to that of the English. As for the situation of men with technical training, we are in a worse position than all the others. One proof: students coming out of the polytechnical school go into economics or management but do not want to be engineers. That is unbelievable! And that is a loss to the country. Finally, as regards receptivity to innovation, the French are rather poorly positioned; but I have the feeling that they are making a bit of progress. The Americans, who were out front, are now losing ground. The English are in a free fall, while the Japanese are very well positioned and are continuing to grow. That is where the greatest danger comes from. That is because the third point is the strongest and pulls along the other two. The three elements are connected; however, the most important is receptivity to innovation, the opening of the minds of a populace.

UN: How can we change this receptivity to technical innovation?

BD: I believe that we have to talk about it a great deal. It is a very psychological matter. In this sector, the media are not aware of their responsibility and power. For example, on television, in newspapers we hear and read quotes from politicians, showbussiness people, writers and occasionally scholars: never an engineer. The public at large does not get the impression that it is noble and worthwhile to be an engineer.

UN: Do you think that will be enough to change people's minds?

BD: No, but if there is no talk about it, nothing will be done. That is a necessary condition, but it is not enough. What has to be done? We could take our inspiration from abroad. One example: every year the president of the United States confers the National Scientific Award upon a dozen dignitaries from the American Scientific sector. There is no such thing in France. Another example: the president of the United States has a scientific adviser, Frank Press, whom he sees twice a week. How many times a week does our president meet with his minister of research? However, it is not only to the public at large that the merit of scientists must be shown. This must also be demonstrated right to the companies. Research is too isolated from these companies. Take a look at the position occupied by research officials and you will get a good idea of the value placed on research by company directors. For some time, we have noted a positive evolution. The fact that Renault has hired Mr Lagasse as scientific director means that the president of Renault intends to give research a more important position. When the president of the CFP [expansion unknown] recruits a scientific adviser of the stature of Mr Cantacuzene, who was a scientific attache in Washington and longtime director of chemistry at the CNRS, a very important position, that is a good sign. But the fact remains that in the United States, company research directors are more often on boards of directors and executive boards than they are in France. In Germany, the situation is even better, as the presidents of three big German chemical companies are all university professors. That is a good sign. Ask a company official who is his most important man: the finance director, sales director or research director? Not one of them will give you the answer which is perhaps called for at this point.

UN: Is this not proof that there has been a loss of confidence in the effectiveness of research?

BD: Research is not a panacea; however, I am convinced of two things which the OECD report stresses in particular: first, a great many problems cannot be dealt with without technical progress; and, second, the potential for technical progress is phenomenal. What electronics, scientific management [bureautique], biology and the science of materials make available to you is absolutely enormous. We still need to install a system which will permit us to take advantage of these advances. However, the leaders of industry are not sufficiently aware of this potential, as they often do not have scientific backgrounds. Undoubtedly there are polytechnical graduates everywhere; however, that does not mean they have scientific backgrounds. Having a scientific background means that a person has spent 10 years in plants and laboratories to understand how to make use of a technical advance. The problem is that between the decision-makers and the technicians there is too often an incompatibility of language. They simply do not understand one another.

8143
CSO: 3102

INCREASED IMPORTANCE ATTRIBUTED TO R & D IN NORWAY

Stockholm NY TEKNIK in Swedish 11 Dec 80 p 16

/Article: "The New Norway: More Room for Research"/

/Text/ Research and development are to be given increasingly more room in Norway. There, as well as here in Sweden, research and development are given priority as a means of stepping up the pace of industry. The oil income provides the opportunities.

Greatly increased funding is proposed in the most recent Norwegian budget. At the same time extensive research cooperation has been initiated with the FRG -- joint research, conducted in Norway, financed by a DM 100 million fund. Discussions are also under way with Sweden concerning the establishment of a similar state research fund. Volvo recently invested a few million in another R and D fund.

From a total viewpoint Norway's research has not been as extensive as for example that of Sweden. According to the definitions of the OECD, Norway belongs to the nations which have "a small R and D effort in absolute terms and average R and D intensity." Sweden is among the countries with average effort and high R and D intensity.

In 197' the Norwegians conducted research for an amount corresponding to 2.1 billion Swedish crowns. (Sweden spent 6.3 billion that same year.)

The reason why the Norwegian R and D intensity up to now has not been very great is, among other things, that the country has not had the same "heavy" investments as Sweden, for example in defense research and nuclear power.

In Norway, as in all the countries which do not have a particularly large research effort, the funds in many areas are spent almost exclusively on keeping up with international development.

The R and D areas in which Norway is now far ahead and in which one intends to make additional investments are, among others, off-shore technology, material technology (in particular plastics and light metals), heat technology and engineering technology.

The two large Norwegian organizations for technical and scientific research in industry are Sintef at Trondheim University and SI /Central Institute for Industrial Research/ in Oslo. Sintef is the largest and had a total budget of about 157 million Norwegian crowns in 1979.

The Central Institute for Industrial Research, SI, has a little less than half the budget of Sintef. SI has slightly more than 300 employees and about 125 of them have a university or advanced institute education.

SI has four main sections: electronics, data systems development, industrial chemistry and material research. Below these sections are very broad areas of technology and science.

Previously, private Norwegian enterprises did not conduct as much research within their own companies as for example the Swedish ones. But the government wants to change all that with an upcoming tax proposal, which will make "in-house" research more interesting.

In the development sector there is a large amount of cooperation across the borders, between companies, within Nordforsk /Nordic Research/ and so on.

11949
CSO: 3102

SCIENCE POLICY

COAL CONVERSION PLANS IN FINANCIAL STRAITS

Hamburg DER SPIEGEL in German 19 Jan 81 pp 46, 48

> [Text] It is extremely likely that the Germans will be pulling out of a very promising energy project. The Americans and Japanese are building the world's largest coal liquefaction plant alone because Bonn does not have any money.

America and Germany, so it seemed, once again were pointing the way for the industrial world, this time away from oil.

Volker Hauff, who at the time was still Bonn's minister for research, and U.S. Secretary of Energy Charles Duncan agreed on a gigantic project "in order to give a clear sign": for DM1.8 billion the partners planned to build a new kind of coal liquefaction plant near Morgantown in the state of West Virginia in the United States.

The prospect of coal fuel soon also attracted the Japanese, who in their energy supply are almost totally dependent on OPEC oil. The new partner was welcome to the Germans and Americans.

In the summer of last year U.S. President Jimmy Carter extended a special invitation to the White House to sign the expanded agreements in order to lend the joint project the appropriate splendor.

Yet now, scarcely one half year after the solemn ceremony in Washington, Adreas von Buelow, Hauff's successor, wants nothing more to do with the plan which was widely praised: "I did not eat steak at the White House."

Even before ground is broken for the planned factory, von Buelow would like to cancel German participation for lack of funds. His calculation is simple: While the budget for research was reduced by DM700 million, the prospective costs for the ambitious project in the American coal district exploded.

According to more recent findings the plant, which is to be finished by 1986 and for which 1.8 billion were planned, will devour about DM2.8 billion. The Germans, by virtue of their 25-percent share (Japan 25 percent, United States 50 percent), would thus have to send to America approximately DM700 million in the next 5 years.

But things will hardly get to that point. Buelow cannot pay the 130 million due this year without endangering the subsidies for small coal liquefaction pilot plants in the FRG.

By withdrawing, the FRG could be missing the boat in a technology in which it was once a leader. In the Third Reich the Germans extracted approximately 4 million tons of fuel per year from coal, using a multistage conversion process--named for Bergius the inventor. That was scarcely one-sixth of today's gasoline requirements in the FRG. And even after the Russian occupation personnel dismantled whole factories in Central Germany the Germans once again soon devoted themselves after the war to coal processing.

Engineers at the Frankfurt Lurgi Co. developed the so-called Fischer-Tropsch process in which coal is first gasified then liquefied. In the 1950's Lurgi helped build the Sasol Works I in South Africa, which annually produced 300,000 tons of fuel using the Fischer-Tropsch process consuming 5.5 million tons of coal.

Yet the plant of the isolated South Africans, who will pay almost any price for fuel self-sufficiency, would be too costly to operate in the FRG. Werner Peters, director of Mining Research Ltd. in Essen says: "Production costs employing this process are 25 percent higher than for the Bergius process." According to the Essen professor basically "much more coal is consumed."

All that would be better in Morgantown. Participation would provide the FRG with know-how in a modern coal hydrogenation technology in a large demonstration plant of 2 million tons of coal consumption and 800,000 tons of heavy oil production each year.

Projects of comparable size which can be built immediately are nowhere in existence in the world. The Saarberg Works does plan a coal liquefaction plant of similar size for the FRG. VEBA [United Electricity and Mining Corporation] and Ruhr Coal even want to plant factories in the countryside that are three times as big.

But their construction is now more than questionable. Suitable sites are lacking because environmentalists protect the noise and stench of the plants.

In addition, the financing of the projects is likewise completely uncertain. Industry complains that it cannot be done without state help. In the FRG's medium-term financial planning, however, not one mark is included for such large oil factories. This much is certain: it will not be possible to put any of these gigantic plants into operation in 1987 as planned.

Withdrawal from the U.S. project is all the more critical. Ruhr Coal and VEBA are only putting a small pilot plant in Bottrop into operation this year. With the demonstration plant in Morgantown, which is 30 times larger, the Americans and Japanese can learn far more about the new technology.

Rudolf Specks, head of Ruhr Coal Oil and Gas Ltd. which was supposed to carry out the FRG's part in the U.S. project, complains that "future export opportunities for German factory construction would be substantially weakened."

But Buelow doubts that. The minister is amazed that so far not one German factory builder has protested with him in favor of the U.S. plant.

Moreover, a congenital defect of the project irritates the minister. According to Buelow these crazy cost increases exist at all only because industry is not financially involved.

Meanwhile, even colleagues who have served longer are following the arguments of the greenhorn minister. Minister of France Hans Matthoefer and Minister of Economics Otto Graf Lambsdorff are shifting to von Buelow's position. Only Minister of Foreign Affairs Hans-Dietrich Genscher is offering resistance to giving up the project. Following the commotion over German military expenditures the FDP leader fears further foreign policy difficulties with the United States. Mainly it could intensify the aversion of the Reagan administration toward the new German-Soviet natural gas pipe deal.

Nonetheless, Genscher is still hoping for a way out. Should the U.S. president in fact apply his campaign slogan "less government--more private initiative" to the Morgantown project, too, plant financing could come under new regulations--if there were participation by interested German companies. Malcom Baldrige, U.S. secretary of commerce-designate, has already announced the involvement of U.S. industry, whenever possible, in government projects.

Genscher would like to see that for the German share, too. Therefore, in the cabinet meeting on 21 January the foreign minister wants to recommend postponing the decision and negotiating with the Reagan administration once again.

If participation by industry does not work out, then even Genscher can no longer say anything against withdrawing from the costly project. The idea of trimming the research budget comes from the FDP.

12124
CSO: 3102

TRANSPORTATION

FORWARD-FACING TECHNOLOGY BECOMES POINT OF CONTENTION

Gelsenkirchen AEROKURIER in German Dec 80 pp 1489-1490

[Article: "The Third Man"]

[Text] The transition from 1980 to 1981 marks the halfway point in the Airbus A310 program: After the start of the project in July 1978, the beginning of production in March 1979, final assembly is scheduled for the coming year, with the maiden flight planned for March 1982. By summer 1983, the smaller brother of the European widebody, the A300, is supposed to go into production. From an economic point of view it is already certain that the 200 to 340-seater will be a hit. The 132-ton maximum weight of this bigbody jet for sparse routes will be pulled by the best engines that have ever been built: the CF6-80 A from General Electric or Pratt & Whitney's JT9D-7R4C. Both engines deliver about 47,000 lbs of thrust (21,300 kp, 209 kN), while again reducing specific fuel consumption. The new supercritical wings will make an even greater contribution to the A310's ability to live up to the reputation preceding it of being the "flying piggy back." Finally, the cockpit equipment will help relieve the airlines' economic problems: The A310 will fly programmed routes. This will save detours, optimize climbing and descent patterns from the economic point of view and--Airbus Industrie argues--lighten the load on the pilot. The European constructors of large aircraft are also trying to have the Forward-Facing Crew Cockpit (FFCC--everyone faces forward) certified for two-man operation. Because of this the pilots' opinions are already becoming heated, 2 and 1/2 years before the maiden flight. Air France cockpit crews were the quickest: They have had a contract since the beginning of the year with their company which says nothing less than that the French A310's will be flown with a three-man crew and conventional cockpit layout. Now things have started to stir at German Lufthansa. The Cockpit Association (VC)--about 80 percent of the pilots and flight engineers of the blue-and-yellow national airline are members--has recently started to moblize the German press. The association argues that the new forward-facing technology, particularly with two men, is a safety risk; it is threatening to fight the measure. There is talk among the pilots of a token strike. Lufthansa, however, is convinced of the quality of the new technology and--after appropriate workload studies have been completed--will have the aircraft in the two-man version. The new pilot workplace in the A310 already has its nickname: The conflict cockpit.

9581
CSO: 3102

EXPERIMENTAL DIESEL ENGINE BURNS COAL-WATER-OIL MIXTURE

Graefelfing ENERGIE in German Nov 80 p 423

[Article by Rudolf Weber: "First Tests with Coal Dust as Diesel Substitute Are Promising"]

[Text] Industry is working on large diesel engines which can save 80 percent in oi--thanks to a fuel that consists of 50 percent coal dust, 30 percent water and 20 percent oil. Sulzer, one of the leading manufacturers of large diesel engines, has lifted the veil of secrecy from the first tests results with this fuel.

The Sulzer test engine for coal sludge has only a single cylinder. With a 760 mm bore and at 120 revs/min, the engine generates 1,500 kW. In addition to oil, it has already consumed coal sludge which contained 32 percent dust from untreated coal. Besides information concerning the permissible proportion of coal dust, the test engine revealed some fundamental limitations which are unknown when operating with pure oil. The two most important ones are these:

--Coal dust burns much more slowly;

--Coal dust itself, and above all the equally finely ground impurities usually present in untreated coal--silicates, for example--affect the cylinder walls and piston rings like emery paper; that is, they increase wear.

Limitation number one means that only slow-running engines like large diesels turning at about 100 revs/min are suitable for powering with coal sludge--in their case the power stroke lasts long enough to burn the coal dust completely. A medium-speed diesel engine or a high-speed diesel for passenger cars, where 4,000 to 5,000 rev/min are the rule, could never be fed with coal sludge.

The second limitation--the danger of wear--excludes engines breathing through valves in the cylinder head. The exhaust valve inparticular would soon be eaten away by hot dust particles. Only the two-stroke diesel (which Sulzer employs exclusively in its large diesel engines) operates without valves, breathing through ports in the cylinder wall. The wear can be kept within certain limits if the coal is treated; that is, if it is largely freed of impurities when being ground. This would have the welcome side effect of also reducing noxious emissions from the engine.

It is apparent from additional but very scanty information that development at Sulzer must have progressed far beyond the experimental stage. There is talk of plans to build a six-cylinder engine with a projected performance of 22,000 hp for coal sludge operation. It is also said that sludge in the composition of 50 percent coal dust by

weight, 30 percent water by weight and 20 percent oil could in future replace heavy oil in large diesels. Injector pumps and nozzles would be able to tolerate the high proportion of coal dust. This would be a saving of 80 percent in oil. These numbers are interesting not only with respect to replacing fuel oil but also to the price of energy--coal dust and water will certainly always be cheaper than, for example, synthetic oil, which is obtained by liquefying coal.

Shipping and energy-heat coupling promise to become two important areas of application for large diesels. In shipping there are signs of a turn away from oil-guzzling turbine propulsion at present, with a turn toward the 25-percent more economical diesel engine--the more distant future could bring coal sludge as well. The block-system thermal power station is unsurpassed for providing smaller cities with power and heat: A large diesel drives the generator, the waste heat provides district heating. This electricity-heat coupling has the unequalled efficiency of over 80 percent! In many places the construction of these block-system thermal stations has been justifiably shunned until now because this would require building on oil and gas. Coal sludge could provide a solution.

9581
CSO: 3102

BRIEFS

VARIG ORDERS AIRBUSES--Varig is now the second Airbus customer in Brazil. In an agreement approved by the Brazilian air transportation authorities, Cruzeiro do Sul has ceded two of the four A200B4-200's it ordered at the end of October to Varig Airlines, which now becomes the 38th Airbus customer. Varig will receive the two machines in June 1981 and June 1982. Additional orders are expected from Varig. The status on 5 November shows that a total of 427 aircraft were on order with Airbus Industrie (287 firm orders, 140 options). Of these there are 283 orders (211 firm, 72 options) for the A300 and 144 orders for the A310 (76 firm, 68 options). [Text] [Celsenkirchen AEROKURIER in German Dec 80 p 1486] 9581

FFCC PROGRAM STATUS--According to Bernard Ziegler, senior vice-president of Airbus Industrie in Toulouse, the controversial program for the Forward-Facing Crew Cockpit (FFCC), in which the engineer's seat is pointing in the direction of flight for the first time, is in the full planning stage. At the beginning of November Ziegler announced:--The FFCC cockpit definition is 95-percent complete.--Software for the CRTs [cathode ray tubes] (the color screens in the new cockpit) is 90-percent "in place."--The illuminated FFCC cockpit mockup is also ready.--the Centralized electronic aircraft control system, ECAM [Extened Communication Access Method], and the electronic flight instrument system, EFIS, are running in the simulator. --The workload study is 50-percent complete.--The start of flight testing for the digital autopilot is to begin by the end of November. In the meantime, A310 customers Lufthansa, Swissair, KLM, British Caledonia, AUA, and Kuwait Airways have agreed to the same FFCC definition. [Text] [Stuttgart FLUG REVUE in German Dec 80 p 11] 9481

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